

Forston Labs NavAutoDrop

(Order Code NavDrop)

The Forston Labs NavAutoDrop is used to perform automatic titrations. This digital sensor can be used in conjunction with a pH Sensor (or other sensor) to perform potentiometric titrations.

What is included with the Forston Labs NavAutoDrop?

- Forston Labs NavAutoDrop sensor
- A cable that connects the Forston Labs NavAutoDrop to a DIGITAL channel of the Forston Labs LabNavigator
- Plastic reagent reservoir
- Plastic valve with a double stopcock fitting (screws onto the base of the reagent reservoir, with a gentle half turn)
- Forston Labs Microstirrer, a stirrer that fits onto the tip of your pH Sensor, and is used along with a standard magnetic stirring plate
- NavAutoDrop sensor booklet (this booklet)

How the Forston Labs NavAutoDrop Works

The Forston Labs NavAutoDrop has an optical-path slot that is 5.7 cm (2.25 in.) in length. When the infrared beam between the source and detector is blocked by a drop of titrant, a digital signal is sent to the LabNavigator, and the data collection program records a drop. The drops are then converted to volume units (e.g., milliliters), using a calibration feature in our software.

Using the NavAutoDrop

1. Assemble your equipment.
 - a. Note that the magnetic stirrer, ring stand, 100 mL beaker, and utility clamp are not included with the Forston Labs NavAutoDrop.
 - b. Arrange your magnetic stirrer on the base of the ring stand. Place a 100 mL beaker on the center of the stirrer.
 - c. Remove the pH storage bottle from the pH Sensor. Insert the pH Sensor body through the larger round hole on the Forston Labs NavAutoDrop.
 - d. Slip the Microstirrer onto the bottom of the pH Sensor. Slide the Forston Labs NavAutoDrop down the ring stand to a level such that the Microstirrer is very close to the bottom of the beaker. Tighten the turn screw of the NavAutoDrop to hold it firmly in place.
 - e. Connect the pH Sensor to CH 1 of the interface, and connect the cable of the Forston Labs NavAutoDrop to the DIGITAL 1 channel.
 - f. Connect the spout and two 2-way valves to the plastic reagent reservoir. **Note:** There are *two* 2-way valves below the reagent reservoir. In these instructions, we will use the *bottom valve* as an on-off valve (either completely open or completely shut). We will use the *top valve* as an adjustment valve, to deliver drops at a slow, consistent rate of about one drop every three seconds.
2. Making sure that both 2-way valves are in the closed position (horizontal), add about 20 mL of titrant to the plastic reagent reservoir. For your first run, we recommend using 0.1 M NaOH solution.
3. Before collecting data, or calibrating the drops, you should adjust the flow rate of the two valves of the reagent reservoir. Temporarily, place another beaker below the spout of the reagent reservoir. First, completely open the bottom 2-way valve; then slowly open the top valve until a very slow drip rate is achieved—a rate of one drop every three seconds, or slower. Now close the bottom valve.
4. Add the solution to be titrated to the 100 mL beaker. For this example, we recommend using about 5 mL of 0.1 M HCl solution. Add enough distilled water so the solution level covers the bulb of the pH Sensor (about 35–40 mL). Use a small magnetic stirring bar and adjust the stirring to achieve good mixing without creating a vortex in the beaker. Optional: Add two drops of phenolphthalein indicator.
Important: Minimizing volumes of solution titrated, and maximizing stirring efficiency will

significantly improve your titration results!

5. Start the LabNavigator App. If your sensor does not auto-ID, manually set up the sensor.
6. There are three different ways to handle the reporting of volume.
 - **Do not calibrate drop volume** In this case, you can skip to Step 8, and begin collecting data.
 - **Manually enter a drops/mL ratio value** If you have done a previous calibration with a particular apparatus, you can enter the drops/mL ratio.
 - **Perform an Automatic drops/mL calibration** You can use a 10 mL graduated cylinder and perform this calibration.
7. Start data collection. **Important:** No data will be collected until the first drop falls through the NavAutoDrop's slot. Completely open the lower 2-way valve (the upper valve should still be set to a slow drop rate). You will now see pH vs. volume data being plotted on a graph. When you are satisfied that the titration has proceeded past the equivalence point, stop the data collection, and shut off the lower 2-way valve of the reagent reservoir. A plot of pH vs. volume will be displayed for your data collection.
8. After collecting data, the program will allow you to view graphs of the first or second derivative vs. volume—second derivative vs. volume is shown here.

To Calibrate Drop Volume (in mL)

To calibrate drops so that the volume of titrant is recorded in units of milliliters, choose Calibrate Drops in your program. The Automatic menu choice helps you to measure the volume of an individual drop by counting the number of drops that pass through the Forston Labs NavAutoDrop and dividing by the total volume of the drops. To calibrate drops:

- a. Place a 10 mL graduated cylinder below the slot of the NavAutoDrop.
- b. Fill the reagent reservoir with titrant.
- c. Choose to start the calibration routine in your program.
- d. Open the bottom 2-way (on-off) valve to begin releasing drops from the vessel through the NavAutoDrop (the top valve finely adjusts the drop rate).
- e. Continue to release drops until there are between 9 and 10 mL of liquid in the graduated cylinder.
- f. Close the bottom valve on the vessel to stop the drops.
- g. Type the precise volume of liquid in the graduated cylinder in the Volume (mL) box of the Calibrate drops dialog box.
- h. Choose to stop the calibration routine of your program.
- i. The number of drops/mL will be displayed. It may be helpful to record the value for that particular reagent reservoir for future titrations.
- j. You can now continue with the titration (return to Step 8 above).

Alternately, the Manual choice allows you to input a previously determined value for drops/mL. Simply enter the drops/mL value (e.g., 28.0), then continue with the titration.

To Calibrate the pH Sensor (or a different sensor)

For many titrations, it will not be necessary to calibrate the pH Sensor. Without calibration, you can expect pH readings to be accurate to ± 0.25 pH units. Having pH offset by this much will not affect the location of the equivalence-point volume. In those cases where a very accurate calibration is required, however, our programs allow you to do a two-point calibration, using two pH buffer solutions. The general procedure, using a pH-4 buffer and a pH-7 buffer as an example, is:

First Calibration Point

- a. In your program, choose to do a new calibration.
- b. Rinse the pH Sensor with distilled water and place it into a buffer of pH 4.0.
- c. Type **4** in the edit box as the pH value. Swirl the sensor, wait until the voltage stabilizes, then choose to keep the calibration point.

Second Calibration Point

- d. Rinse the pH Sensor with distilled water, and place it into a buffer of pH 7.0.

- e. Type **7** in the edit box as the pH value for the second calibration point. Swirl the sensor and wait until the voltage stabilizes. Click Keep, then click OK. This completes the calibration.
- f. You are now ready to collect data using the new calibration. **Note:** If you want to use these new calibration values at a later time, you can simply record the slope and intercept values found on the Manual Entry tab and type them in when needed.

The Manual Entry tab allows you to enter the Slope and Intercept values determined during a previous two-point calibration.

Typical Titration Data

Helpful Tips for Using the Forston Labs NavAutoDrop

- A slow drip rate (three seconds per drop or slower) is important. This provides enough time for the drop to be added to the solution and thoroughly mixed, and the pH (or other sensor) to respond. When passing through the equivalence point, without adequate stirring after addition of drops of titrant, you may see a resulting delay or lag. Even if this lag is barely noticeable in the pH vs. volume graph, it will be more apparent in the follow-up first or second derivative graphs. Following some or all of these tips will reduce or eliminate this error.
- It is also helpful if the amount of titrant in the beaker is minimized. Less liquid means faster mixing. This is why we recommend using a 100 mL beaker instead of a 250 mL beaker whenever possible.
- Using the Forston Labs Microstirrer helps deliver solution directly to the pH bulb, increasing response to a fresh drop.
- Add only as much distilled water to the solution being titrated as is necessary to cover the bulb of the pH Sensor (or other electrode). If you are using a 100 mL beaker and a small stirring bar, you may need as little as 15-20 mL of solution. If you use the Forston Labs Microstirrer, you will need more solution to cover the bulb (35–40 mL), but you may get better mixing.
- Using the plastic reagent reservoir that is supplied with the NavAutoDrop, instead of a standard buret, provides a wider diameter and less change in the hydrostatic pressure per unit volume of titrant above the 2-way valve.
- Another advantage of using the plastic reagent reservoir is the pair of 2-way valves, using one for drop rate adjustment, and the other as an on-off valve. This eliminates the need to do a fine adjust during the initial readings, and also allows the user to set a consistent rate, along with a calibration of drops/mL.
- If you want to allow for more thorough mixing when you are near the equivalence point, you can also manually release drops at a slower rate for that region of data.

Using other Sensors with NavAutoDrop

Forston Labs NavAutoDrop can be used with other Forston Labs sensors such as our Ion-Selective Electrodes, Conductivity Probe, or Forston Labs pH Sensors that do not auto-ID. It can accommodate third-party electrodes when used in conjunction with our Electrode Amplifier. It can also take simultaneous pH and temperature readings, as shown here. To use any of these other sensors, use the following instructions.

	Slope	Intercept
Conductivity (0–200 $\mu\text{S}/\text{cm}$)	65.70	0
Conductivity (0–2000 $\mu\text{S}/\text{cm}$)	847.2	0
Conductivity (0–20000 $\mu\text{S}/\text{cm}$)	7819	0
ISE (mV)	137.55	–168.23
Electrode Amplifier (mV)	223.21	–390.63
pH Amplifier (mV)	223.21	–390.63
pH Amplifier (pH units)	–3.838	13.72

LabNavigator

1. Set up the equipment and start LabNavigator App.
2. If your sensor does not auto-ID, choose Sensor Setup from the Sensors menu.
3. Open the drop down menu next to the Channel in which the sensor is connected. Select the sensor you are using from the list.
4. Select OK to continue.

Forston Labs AutoDrop Specifications

- Detector rise time: <70 ns
- Detector fall time: <70 ns
- Power requirements: 55 mA at 5 VDC
- Infrared source: Peak at 890 nm

Limited Warranty

Forston Labs warrants this product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer. This warranty does not cover damage to the product caused by abuse or improper use.



Measure.Analyze.Record

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